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TOMATO GROWING.

BY

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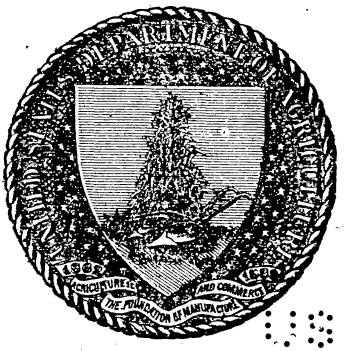

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UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., May 19, 1898.

SIR: I have the honor to transmit herewith an article on tomato growing, by Edward B. Voorhees, M. A., director of the New Jersey Agricultural Experiment Stations and professor of agriculture in Rutgers College, including notes on the fungus diseases of tomatoes, by Byron D. Halsted, D. Sc., botanist and horticulturist in the same institutions. This article includes the results of investigations and observations made by the New Jersey stations under the supervision of the author, as well as of those made at other experiment stations and elsewhere. The publication of this article as a Farmers' Bulletin is respectfully recommended.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

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TOMATO GROWING.

INTRODUCTION.

The tomato is adapted to a wide variety of uses in the household. It is easily grown as a general crop, bears shipping well, and can be provided throughout a long season. For these reasons, among others, it has come to be one of our most important vegetable crops. The method of culture varies with the object or purpose of the crop. The latter is usually classified as follows: (1) For early market, (2) for the medium and late market, and (3) for the cannery. To these should be added the greenhouse crop, which is beginning to assume considerable importance in some localities. The tomato is most important as an early market crop, probably exceeding in value any other one crop, particularly in the Middle and Southern Coast States and in the market-garden regions near all large cities. In the past the States of largest production have been New Jersey and Maryland, while in recent years the crop has become a prominent one in the Southern Coast States—Florida, Georgia, the Carolinas, and Virginia, the first of which begins to supply the markets in February. Thus a continuous supply is provided from the field from that date until late in the autumn. Statistics as to the total areas grown are not available, although for New Jersey the data gathered indicate that at least 2,500 acres are devoted to the early market crop, yielding on the average 300 five-eighth bushel baskets, each weighing 40 pounds, or a total crop of 6 tons per acre. The gross price per basket ranged from 25 cents to $2.

The area devoted to the medium and late market crop in the Middle States, though not so large, is very considerable, and the prices received are relatively lower, although it is regarded as a profitable crop.

The tomato is grown more largely for canning than any other vegetable used for this purpose. The total annual pack of the entire country now averages nearly 5,500,000 cases of 24 cans each, and the area required to supply the canneries is estimated to exceed 300,000 acres. The bulk of the crop for this purpose is, however, grown in a few States, Maryland leading, with over 1,000,000 cases, and New Jersey following, with from 500,000 to 700,000 cases. The four States, Maryland, New Jersey, Indiana, and California, produce about three-quarters of the entire pack, and New Jersey and Maryland produce nearly

one-half. The other States of considerable production are, in their order, Delaware, Missouri, Ohio, Virginia, and Iowa. It is thus observed that this crop is adapted to a wide area and is an industry of very considerable importance in a few of the States.

The discussion of the culture of this crop will follow the classification already suggested, except where methods practically coincide in the different classes.

FOR THE EARLY MARKET.

While the great development of the greenhouse industry enables the consumer to secure tomatoes throughout the entire year, those grown in the open field reach the Northern markets from Florida about the first of February and are followed by supplies from States farther north until about the middle or latter part of June, when they begin to come from Maryland, Delaware, New Jersey, and New York (Long Island), localities within the immediate vicinity of the large cities—New York, Philadelphia, and Boston. Inasmuch as the bulk of the early tomatoes, so called, are from these latter States, the consideration of methods will apply mainly to the crop as grown in those States, though the suggestions as to the general methods of culture apply quite as well to other localities.

SELECTION OF VARIETIES.

The first point of importance in the successful growing of the tomato crop is the selection of varieties, and while a number are recommended by seedsmen as the "best," no one variety fulfills the idea of "best" for all localities. This is mainly owing to differences in the climate, season, and character of the soil, as well as the demands of the different markets. Hence the right selection is a matter which rests largely with the individual grower. He must determine for himself which is the best for his conditions. The best early varieties, owing to the comparatively short time during which attention has been given to the matter of their development, doubtless belong to the same strain. The following-named varieties all possess one or more valuable characteristics, and in many cases but little difference is observed in them either as to quality or earliness. From this list varieties most suitable for the different localities may be selected. The order in which they are named has no particular significance:

List of more important varieties of tomatoes.

Livingston Beauty.	Early Ruby.	Atlantic Prize.
Dwarf Champion.	New Stone.	Fordhook.
Maule Imperial.	Early Jersey.	Acme.
Extra Early Richmond.	Matchless.	Table Queen.
Improved Trophy.	Perfection.	Stone.
Mikado.	Trucker Favorite.	

The chief difficulty in the matter of varieties is that the earlier sorts as a rule do not possess the best market qualities—that is, solidity of flesh and smoothness. They are too frequently irregular in outline and

possess large seed cavities. The peculiar demands of the market, too, should be considered, for while in all markets the quality as above defined measures, as a rule, the price received, certain markets demand characteristics, such as color and shape, to a greater degree than others. Certain consumers are very strenuous in the matter of color. The purplish-tinted varieties, which are claimed to be sweeter, bring a much higher price in some markets than those of a bright red color, while in other markets the bright reds lead and the former are not so eagerly sought. Hence, as already stated, the question of variety is to be determined largely by the grower, and the best growers as a rule aim to grow and improve that variety which does best under his conditions—that is, he does not depend altogether upon seedsmen, but selects and saves seed of the particular variety which fulfills his aim as to earliness, vigor, habit of growth, size, color, and form. He selects his seed from the first ripening fruit upon strong and vigorous plants, and though this method is expensive, it is believed by those who practice it that the gain in earliness, yield, and quality of the fruit the ensuing season more than balances the extra cost. One or two days' gain in the earliness of finer-quality tomatoes frequently makes a difference in the market price of from 50 cents to $1 per basket.

GROWING THE PLANTS.

In the growing of early tomatoes the proper kind of plant exerts a great influence upon the product, and too much stress can not be laid on the necessity of giving close attention to the little matters of detail which to an ordinary observer are apparently of no consequence. Success with this crop requires that not a single point should be neglected in the growing of the plants. The aim is to anticipate nature, to get ahead of her in all points, and hence all of the operations necessary to this end must be executed with intelligence and promptness and with the greatest care. All conditions should be made favorable for rapid germination of the seed and the quick, healthful growth of the plant from the time the seed is planted until the crop is harvested.

The tomato is a plant that revels in high temperature, and is not only retarded in growth, but is injured by a low temperature during its early growth. From 60° to 80° are the limits of temperature range; hence the first desideratum is that the plants for early fruiting shall be grown either in a hothouse or in the hotbed, where the temperature can be controlled. The house is preferred by many, though both methods are very successfully used.

The seed should be planted any time from the middle to the latter part of February in the Middle States, and in the other States earlier or later, according to the locality. If grown in the house, they should be planted in a fertile soil and one that will not bake or crust. An abundance of vegetable matter is desirable. Lines are marked out in the bed 6 inches apart, and not over one-half inch in depth, and the seed distributed in the rows, averaging, as nearly as possible, four to the inch.

If planted thicker, the seedlings should be thinned to this distance after they are up, and in no case should they be left to stand any thicker if good, strong, healthy, stout, and stubby plants are desired. With good soil and with proper attention the seedlings should appear in from eight to ten days. When the seedlings are well up, the treatment should be such as to prevent long and spindling growth, which is frequently caused by an oversupply of water and too high temperature. Careless watering may also result in damping off and in a too soft and succulent growth. It is better for the plants to have too little rather than too much water. If the seedlings have been properly cared for, they should be ready for transplanting in about a month or six weeks.

Many persons now use for this purpose the cheap plant boxes, 6 by 6 by 5 inches, in the house, rather than to transfer to a cold frame. In putting the plants in the boxes one man fills each box about half full of a compost made up preferably of an even mixture of horse and cow manure, to which is added for each ton an equivalent of from 20 to 25 pounds of nitrogen in the form of dried blood, tankage, or cotton-seed meal, and then passes the box to another man, who fills the remaining space with any good soil—that from the bench in the greenhouse answers the purpose—and the box is then placed upon the bench in the greenhouse. From this time on the plants should be well watered and the temperature kept at from 60° to 75° F. in the daytime and not lower than 50° at night, with proper ventilation as needed.

If these conditions are carefully complied with, the plants will be strong and healthy.

In growing the plants in a hotbed, fresh stable manure is put in to a depth of 18 inches. This is covered with 5 inches of good soil, and the seeds sown as described. When the plants have made four large leaves and are beginning to develop, which usually requires about a month or six weeks, they are ready for transplanting, though the work should be done only when the weather conditions are favorable, and by a careful person. It should not be done on cold or stormy days, nor by a person who does not understand the work.

In making the cold frames two important points should be observed: (1) They should have a pitch of about 6 inches, in order to carry off the water, and (2) the soil should be well manured, say a ton of stable manure to twenty 3 by 6 feet sashes. This length of bed is very desirable, as there are no corners and no cross pieces to obstruct the light. After the manure is in, care should be taken to make it perfectly smooth, so that the depth of soil (about 5 inches) may be uniform, as different depths of soil will cause a variable growth and a larger proportion of poorer plants, besides making the bed very uneven. The soil should be raked down level, the sash put on, and the bed allowed to remain at least two days to settle and become warm before the plants are introduced. When the plants are ready to be set, the bed should be stirred to destroy any weed seeds, and then marked off in checks 4 or, preferably, 5 inches each way.

After the plants are placed in the bed their subsequent development will depend very largely upon the care given to them. In a general way the main precautions to be observed are: Not to keep the plants too warm, and to give them air and water when necessary. Too little air and too much water have a tendency to make tender plants, although, on the other hand, if given too little water they are retarded in their growth and seem never to be able to recover from the check.

When the weather becomes warm, the sashes should be entirely removed on clear days, in order that the plants may be gradually hardened for setting in the open field. It is desirable to allow the beds to be entirely open all night a few times previous to setting. If proper attention is given to the plants during this critical period, they should be ready for the field from the 1st to the 10th of May. They should be from 12 to 15 inches in height, with strong, well-fibered stalks as thick as the finger, with a number of crown blossoms and numerous side branches.

SELECTION AND PREPARATION OF THE SOIL.

While the tomato is adapted to a wide variety of soils, it must be remembered that the aim here is early maturity; hence a too fertile soil, or one in which the fertility is widely distributed, and which is desirable where a general crop is grown, is to be avoided, since such soils tend to produce a too rapid and too large growth of vine, thus partially defeating the purpose in view, namely, a quick growth of plant and a rapid development of fruit. The active fertilizing matter should be concentrated within the immediate reach of the roots. A soil not naturally very poor, in which the added fertility may be provided, both as to place and time, as will best serve the purpose, is most desirable. A light, sandy loam, high and well drained, is perhaps the ideal for early tomatoes, provided the proper nourishment is given from artificial sources.

The previous treatment of the soil should be such as to free it from weeds and to leave it in a thoroughly friable condition. A crop of corn, potatoes, sweet potatoes, or melons is better to precede tomatoes than a hay crop. A clover or timothy sod, or a green crop, such as rye, may, however, precede, provided it is plowed either in fall or very early in spring, in time to permit of a thorough mellowing by cultivation before the plants are set. After this preparation the usual practice is to open furrows 4½ feet each way, throwing the dirt both ways, and leaving a furrow at least 8 inches deep and 10 inches wide at the bottom.

SETTING THE PLANTS.

The setting in the field should not begin until the weather is settled. A warm, bright day should be selected, and the work pushed as rapidly as possible. If set on a cold, dark day, the beginning of growth will not only be greatly retarded, but the early settings are liable to be blasted. The plants should in all cases be thoroughly watered, in order

to obviate as far as possible any bad effect from immediate drought or hot weather. If the plants have been grown in boxes, the operation of planting may be carried on as follows:

For carting to the field, a low-wheeled wagon lengthened to 16 feet, on which a plank is placed which will carry about 225 plants, is very convenient. When in the field boys carry the boxes and set them by the hills; two men follow, take the boxes in hand and turn out the block of earth with the plant. If manure has been used in the hill, this is divided and the plant placed in it and surrounded by the manure. Another man follows with a hoe and draws the loose soil from both sides of the furrow around the plant, and presses it firmly with his feet.

Plants thus set rarely wilt or feel the effects of the setting, and start at once into new life and vigor of growth. If the conditions are favorable, new roots will be formed in forty-eight hours.

If the plants have been grown in cold frames, they are cut in blocks, say of from four to six plants, and lifted with a fork and set in the wagon, the same as in the bed. When the field is reached, each plant is cut out singly and set in the hill with all the soil adhering to the roots. The setting is done as in the former case.

MANURES AND FERTILIZERS.

The feeding of the tomato, as generally practiced, is accomplished in three ways, all of which are good—the cost of labor and manure usually determining the method used: (1) By means of farm manures; (2) by farm manures and commercial fertilizers, and (3) by commercial fertilizers alone. When manures only are used, they are usually spread broadcast upon the soil in the fall or winter, not later than February or March, and thoroughly worked in previous to putting out the plants, and at the time of setting a small shovelful of manure is placed in each hill. This method works well, though on soils reasonably rich the tendency is to cause too vigorous a growth of vine, and thus retard the maturity of the fruit. Where manures and fertilizers are used, the manures are usually applied in the hill, and the fertilizers are used both at the time of setting and again after the growth of the plants has well started. Where fertilizers only are used, they are applied around the plants in small quantities at the time of setting, and again in larger quantities after the plants have well started.

The impression is quite prevalent that the tomato does not require heavy manuring. Experiments that have been conducted at a number of experiment stations[1] show that the tomato is a plant that quickly and profitably responds to the use of manures or fertilizers, and that the maturity and yield are very largely influenced by the method of manuring and fertilizing. Experiments conducted by the New Jersey

[1]New York State Sta. Buls. 21 and 32; Georgia Sta. Bul. 17; Maryland Sta. Rpt. 1891; Virginia Sta. Bul. 11; New Jersey Stas. Bul. 79, Special Bulletin O, Rpt. 1892.

Station upon three farms, located in different parts of the State, and during four seasons, to test the effect on maturity and yield of nitrate of soda in different quantities and at different times, both with and without the mineral elements, phosphoric acid and potash, in comparison with barnyard manure, showed (1) that nitrate of soda was one of the best nitrogenous fertilizers for this crop, and that its use in small quantities (160 pounds) per acre in one application, or in large quantities (320 pounds) in two applications increased the yield materially, but not at the expense of maturity, and that this was equally true when used alone and when used in connection with phosphoric acid and potash; (2) that nitrate of soda, when used in large quantities (320 pounds in one application) in the presence of a sufficient excess of phosphoric acid and potash, did increase the yield, but at the expense of maturity, and (3) that when properly used nitrate of soda was a profitable fertilizer for the crop. This latter point is strikingly shown in the following tabulation of the value per acre of the increased yield:

Value per acre of the increased yield of tomatoes due to use of fertilizers.

Fertilizers per acre.	1889.	1890.	1891.	1892.	Average of four years.
Group 1, 160 pounds nitrate of soda	$59.80	$28.80	$79.60	$35.40	$50.90
Group 2, 160 pounds nitrate of soda, 320 pounds bone black superphosphate, and 160 pounds muriate of potash	55.40	12.80	60.20	40.80	42.30
Group 3, 320 pounds nitrate of soda	51.20	17.80	37.80	50.80	39.40
Group 4, 320 pounds nitrate of soda, 320 pounds bone black superphosphate, and 160 pounds muriate of potash	47.00	9.80	10.00	33.00	20.05
Minerals alone, 320 pounds bone black superphosphate and 160 pounds muriate of potash	32.40	2.80	61.20	34.20	32.65
Barnyard manure, 20 tons	11.80	21.40	16.40	40.00	23.40

The effect on total yield of the use of nitrate of soda alone and in combination with mineral elements, as compared with barnyard manure, is also shown in the accompanying tabulation, in which the yield of the different fertilizers is compared with the unfertilized land, which is represented by 100:

Comparative yields of tomatoes for four years, the yield on unfertilized plats being taken as 100.

Fertilizers used.	Comparative yield.				Average for four years.
	1889.	1890.	1891.	1892.	
Plat 1, no fertilizer	100	100	100	100	100
Plat 2, nitrate of soda alone, 160 pounds per acre	133	133	154	142	141
Plat 3, nitrate of soda alone, 160 pounds per acre	139	152	153	139	146
Plat 4, nitrate of soda alone, 320 pounds per acre	132	151	177	150	153
Plat 5, nitrate of soda alone, 320 pounds per acre	136	142	169	163	153
Plat 6, minerals containing phosphoric acid and potash only	105	121	120	131	119
Plat 7, nitrate of soda, 160 pounds per acre, and minerals as in plat 6.	131	126	160	159	144
Plat 8, nitrate of soda, 160 pounds per acre, and minerals as in plat 6.	154	133	161	140	148
Plat 9, nitrate of soda, 320 pounds per acre, and minerals as in plat 6	145	149	161	149	151
Plat 10, nitrate of soda, 320 pounds per acre, and minerals as in plat 6.	158	147	159	147	153
Plat 11, barnyard manure, 20 tons per acre	107	120	113	153	123
Plat 12, no fertilizer	100	100	100	100	100

A study of these yields shows that nitrate of soda was superior to both barnyard manure and mineral fertilizers alone, and that nitrate of soda alone was, on the whole, but slightly less effective than the complete fertilizers.

These results have been confirmed both by the experiments of the stations referred to and also in actual practice on soils similar in character, namely, those which were well adapted for the early tomato—light, well-drained, sandy loams—which had been previously well manured for crops entering in the rotation. The results do not apply in the case of very poor soils, or upon heavy clays, which are not adapted to the early crop. The statement that it pays to fertilize early tomatoes and that nitrate of soda is one of the best nitrogenous fertilizers for the crop is true, though modified always by the condition of soil and the purpose of growth. A scheme of fertilizing for early tomatoes is here outlined, which, when the conditions are observed, will be likely to give as good returns if not better than any other.

For example, on soils which have been well supplied with the mineral elements, phosphoric acid and potash, by previous manuring or fertilizing, a fertilizer very rich in nitrogen (in the form of nitrate) and low percentages of phosphoric acid and potash, should be used. The fertilizer applied at the time of setting the plant should furnish nitrogen equivalent to from 80 to 100 pounds of nitrate of soda (13 to 16 pounds of nitrogen), and a second application of an equivalent amount should be made from three to four weeks later. A single application of the amounts here suggested, at the time of setting the plants, would, under good seasonal conditions, give quite as good results as a fractional application, although, if larger quantities are used, two applications would be better, since the nitrate is extremely soluble and if applied in large amounts at one time loss of nitrogen by leaching might occur in certain cases, resulting in a deficiency of food, and thus preventing the normal development of both plant and fruit.

On soils that possess only good mechanical condition, and are very poor in plant food, a heavier application of both nitrogen and the mineral elements will be required, in which case the following plan of fertilizing is recommended:

Previous to setting the plants, or at the time that they are set, apply 600 pounds per acre of a mixture of 400 pounds of acid phosphate and 200 pounds of muriate of potash, and thoroughly harrow or cultivate into the soil, and at the time of setting apply around the hill 100 to 150 pounds per acre of nitrate of soda.

Three to four weeks later, make another application of from 100 to 150 pounds per acre of nitrate of soda. Owing to the small bulk of the nitrate, it should be mixed with dry soil or sawdust in order to insure even distribution, the only precaution to observe is to prevent its immediate contact with the plant roots.

This method possesses two advantages, (1) the plant is provided with nitrogen in an immediately available form at the time when it is needed,

namely, when it is set in the field, and thus no delay in growth is caused, and because of the presence of the mineral elements either in the soil or in the fertilizer applied no excessive growth of vine is encouraged by the use of the nitrate, as would be the case were the mineral elements absent; (2) the nitrate is applied around the plant within the immediate reach of its roots, and since it is all in an immediately available form, which may be used up rapidly, the tendency to late plant growth, a result of a continuous supply of nitrogen, is not encouraged, and a normal and rapid growth and development of fruit results.

It is not claimed that by this method of fertilizing maturity is hastened in the sense that the date of the first picking is earlier, but that a larger number of fruit is picked earlier. It was not shown in any of the experiments that the date of picking was earlier by virtue of the nitrate; in fact, the earliest tomatoes were picked upon land where the minerals only had been applied. The yield here, however, was not satisfactory, but where nitrate was applied the crop was so greatly increased that a larger proportion of early tomatoes was secured. It is obvious that inasmuch as the price of the fruit rapidly declines as the season advances, receipts will be materially increased by the increased crop of earlier fruits.

Where it is desirable to use yard manures with fertilizers, because of the abundance and cheapness of the former, they should be applied broadcast, and the nitrate applied at the time of setting the plants, as already described, rather than both in the hill together, as the tendency in the latter case would be to cause a loss of nitrogen from the nitrate, depending upon the amount of organic matter in the manures. That is, both experiments and experience have shown that manures will, under these circumstances, cause more or less of the nitrogen of the nitrate to escape as gas. Another precaution to observe in the use of yard manures for early tomatoes is, not to use too large quantities, as they are virtually nitrogenous manures, which, because of their character, feed the plant in proportion to their rate of decay, hence the presence of large quantities will encourage not only an undue growth of plant, but a late growth as well.

The mineral fertilizers, such as acid phosphate and muriate of potash, can be used with the yard manure with perfect safety, in fact with great advantage, because supplementing their lack of the mineral constituents.

CULTIVATION OF THE CROP.

Cultivation of the soil should begin the next day after setting the plants, in order to counteract the effects of the treading and packing of the soil due to the setting, and thus to aid in warming up the soil and to prevent a too rapid evaporation of water. The crop should be cultivated after every rain, and should no rain fall for a considerable time it should be cultivated every week until the vines fall, when the plants

can take care of themselves. The chief object in cultivation here is to rid the land of weeds, to conserve moisture, and to keep the surface soil warm. Any more frequent cultivation for the sake of furnishing plant food is not desirable when the fertilizing has been carried out as suggested.

YIELD PER ACRE.

Plants handled and fertilized in the manner described should produce ripe fruit in from five to six weeks. In New Jersey the picking is usually completed early in August, though much, of course, depends upon the variety in this regard, and also upon the weather conditions at the time of the first setting of the fruit. If the weather is bad, then the main crop must be derived from the second setting, which will lengthen the period of picking. The yield per acre also varies widely, due both to variety and weather conditions. Some varieties may be regarded as shy bearers, while others are very prolific. In certain seasons the weather is favorable for the crop, warm and dry at the right time; in others, unfavorable, cold, wet, and backward.

A good average yield on land well adapted to the crop, and when the conditions are favorable, is about 250 bushels, though the yield may range from 100 to 500 bushels per acre. Tomatoes are not, however, sold by the bushel, but by the basket or crate, the basket holding, as a rule, five-eighths of a bushel, and the crate three-fourths of a bushel.

GROSS AND NET RECEIPTS.

The gross receipts from good growers average about $200 per acre, though the range, as heretofore indicated, will be from $100 to $500, the receipts per basket or per crate depending somewhat upon the season. In seasons of large production the price per package will be lower, and in the season of small production the price per package will be higher, making the gross receipts about the same, though the net receipts vary according to these circumstances, chiefly because of the larger amount of labor involved in the larger crop and the increased charges for freight rates and cartage.

The net receipts or profits in the growing of tomatoes, as will be observed from the preceding statement, will depend upon the care and judgment exercised in all of the various steps that have been mentioned, though too great stress can not be laid upon the necessity of extreme care in growing the plants. It is on this, other things being equal, that the profit hinges, for without a good plant a good crop can not be expected unless the other conditions are unusually favorable. In the handling and marketing of the crop much depends upon the care used in carting and packing. It does not pay to send poor stock to market, though, as already stated, the earlier varieties are not, as a rule, of as high quality as those produced later—the quality being determined by color, shape, and solidity. Tomatoes partially green, or those which are intermixed with rough specimens, and those containing

a considerable proportion of smaller or overripe fruit do not bring the highest price in the market, and the tendency of such stock is to reduce the consumption and hence the price of the good product.

Estimates of expenses per acre by experienced growers in New Jersey are as follows:

Cost of growing tomatoes in New Jersey.

Cost of plants, at $15 per M	$32.00
Preparation of land, setting of plants, and cultivation	9.00
Manures and fertilizers[1]	27.50
Picking and carting to depot	20.00
Total	88.50

The rent of land, which would vary from $6 to $15 per acre, and the freight, cartage, and commission, which are variable factors, are not included in this estimate.

MEDIUM-EARLY AND LATE CROPS.

The medium-early and late crops of tomatoes may follow after peas, early radishes, spinach, and crops of that sort, and since they may be set in the field later, less expense is necessary in the growing of the plants, though for good, strong plants, the seed should be planted early in March in the States of largest production. The seed may be sown in a well-prepared bed, in rows 6 inches apart, the seeds averaging about four to the inch in the row. With good conditions and care, the plants should be well developed early in May, and they should then be transferred to a cold frame, prepared as for the early sorts. In transferring the plants as much root as possible should be saved. Owing to the advanced season, the danger of frost being past, the sashes may be taken off and the plants left to the natural climatic conditions, preparatory to setting in the field, which may take place early in June.

SOIL AND MANURES.

The soils best adapted for these crops, as for the very early, are well-drained, sandy loams, although, as the object of the growth is different, those richer in natural fertility are preferred.

While it is desirable, as in the case of the early tomatoes, to hasten growth, and to encourage continuous growth, the soil should be well prepared and quick acting fertilizer applied, though the amount may be reduced at least one-half (preferably omitting the second application), particularly on good soils, as the conditions during the season of growth are favorable for the rapid changing of the organic nitrogen in the soil into active forms.

The setting of the plants and the methods of cultivation, already described, should be followed. The yield per acre for good soils, when the proper conditions are observed, should average about 300 bushels.

[1] If fertilizers only are used, this item may be very much reduced.

The prices received for this crop are usually very much lower than for the early crop, though much depends upon the season and yield. When the early season is cold and wet the net value of a second early or late crop is often quite as great as that of the early crop, owing to the fact that the chief expenses—the cost of plants and of fertilizers—are reduced, the former from $15 to $5 per M, a saving of $20 per acre, and to a saving of at least $5 per acre in the fertilizers. Good growers expect about $100 per acre as the gross value of the crop.

TOMATOES FOR CANNERIES.

The tomato is now so largely grown as a regular field crop that it might seem as if but little could be said concerning the methods to be observed, although, as in the other cases, success requires definite knowledge and careful practice along the four lines already emphasized: (1) The selection of the variety; (2) the growing of the plants; (3) the selection and preparation of the soil; and (4) the fertilizing and cultivation of the land.

SELECTION OF THE VARIETY.

Owing to the fact that in canned tomatoes it is difficult for the average consumer to note any deficiencies in the appearance of the original fruit, many labor under the delusion that any variety will do for this purpose. This is a mistaken idea, as quality in canned goods is now an important factor, and it is quite as necessary that a good quality of product should be used, as in growing for the early or general market, though from the field side it is natural that tonnage should be a primary consideration.

In the matter of varieties, as in the case of the early tomatoes, too much dependence should not be placed upon the name or upon the fact that a neighboring farmer secures good results from a given variety, since there are so many variations in the character of soils, even in the same locality, which exert an influence upon the size and quality of crop that the best variety is usually one that is, in part at least, developed by the individual grower. The main point is to select varieties that produce large, smooth, solid fruit, that ripen to the stem; those which possess size as their chief characteristic are frequently of poor quality, as they are likely to possess large seed cavities and to ripen unevenly. The Stone, Paragon, Ten Ton, Cumberland Red, and Livingston Perfection are all varieties that have been grown with advantage, though, as before stated, the variations due to the conditions cause a considerable change from the original variety. In fact, in many localities no definite variety name is known, neither is it known where the original plant came from, and thus it assumes a local name, as, for example, in New Jersey, the "Jersey Red" is probably grown more largely than any other, though it possesses very different characteristics in different

localities, and is a development and improvement of some good variety introduced at an earlier period.

The conditions are such in some sections as to prevent the canners from making as much distinction between good and poor varieties as they would like to do. Largely owing to the liking of the growers for the large sorts, the coarser varieties, which give a heavy yield, have been substituted for those of finer texture, although there has been a gradual improvement in this regard. Canneries are in a measure obliged to receive all that come, unless they can control absolutely the land upon which they are grown. Frequently differences in the quality of the crops of different farmers will make a difference of from 25 to 40 cans on a ton of fruit, or from 6 to 10 per cent, a very considerable item. In good seasons and with good fruit, 400 cans may be regarded as the maximum amount to be derived from a ton, though late in the season, and with poor varieties, as already stated, the pack from a ton is very much less. The interests of both the grower and the canner are really identical in this regard. An improvement in the quality of the fruit will result in an improvement of the canned product and a consequent increase in the price of both the raw and manufactured products.

GROWING THE PLANTS.

The care and expense required in growing the plants for the crop for canneries are less than for the other crops, though the matter of plants is still a very important one. Here as in the other cases, good plants are a necessary factor for success. A good crop from poor plants can result only when all other conditions are extremely favorable.

In the growing of plants it is necessary to select a sheltered spot, either natural or artificial; the lee side of a high board fence, or building, is a desirable location, the main object being to protect the plant from the cold north and northwest winds.

The bed may be prepared either by working into a well-drained soil an abundance of well-rotted or composite manure, or by applying to it fertilizers of the right kind—that is, such as are soluble and available, and which at the same time will not retard germination or injure the young plantlet. As a rule, manures are preferable, as dressings of mineral fertilizers to provide the food required would naturally have a tendency to retard germination. After the bed is prepared it should be raked fine, all clods pulverized, and manure applied.

The seed should be planted shallow, as at this season of the year there is still a deficiency of warmth, and the nearer the surface the seed are planted the quicker they will germinate. As a rule, they should not be deeper than one-quarter of an inch, and the earth around the seed firmly packed, which can be well done by means of a board 1 foot wide and of a length equal to the width of the bed. This board will also do to stand on when sowing the seed. A light covering of salt hay, or straw, is also beneficial immediately after planting, in order to

absorb the heat from the sun, and at the same time to keep the surface soil loose and prevent baking. The covering, however, should be removed before the seedlings break through the soil, otherwise the plants will be drawn and worthless. When the plants are an inch high the soil should be stirred. This stirring should be repeated frequently, particularly after each rain, as it induces more rapid growth, and more freely admits the warm air to the roots of the plant. Unless there is an abundance of rain, careful attention should also be given to watering, as the plants require a great abundance of water. If all these precautions are carefully observed, and the work properly carried out, good, strong, well-fibered plants should be ready for the field from the middle to the latter part of June—the time which they are usually set in New Jersey or Maryland. In other States the planting of the seed would naturally be a little earlier, thus making the setting in the field proportionately earlier.

SELECTION AND PREPARATION OF THE SOIL.

The tomato as a field crop is adapted to a wide variety of soils, though a medium clay loam is probably the best. In fact, any soil well adapted to potatoes will grow the tomato to good advantage. The previous treatment, however, has an influence on the best development of the crop, and a clover sod, or a soil upon which corn has been the preceding crop, is perhaps the best. In either case the land should be deeply cultivated, preferably in the fall or early spring, in order to improve its physical character and to destroy injurious insects,[1] which may be troublesome later. It is also desirable, where it is the practice to use manure, particularly if it is coarse, to spread it during the winter, in order that the soluble portions may become thoroughly distributed in the soil. As soon as the land is ready to work in the spring it should again be plowed shallow and then deeply cultivated, in order to thoroughly warm up the soil and to incorporate in it the coarser portions of the manure.

FERTILIZING AND CULTIVATION OF THE SOIL.

In manuring and fertilizing, the character of the crop and the season of its growth should be remembered. Hence recommendations that were made for the early crop do not apply in all cases, except, perhaps, on the poorer classes of soils. In the first place, the plants are not put in the soil until summer, when the conditions are most favorable for the rapid change of organic forms of nitrogen into nitrates, and thus if the soil has been manured, or is naturally rich in vegetable matter, the additional application of nitrogen in immediately available forms is not so important. In the second place, the object of the growth is not early maturity, but the largest yield of mature fruit. Hence it is more desirable to grow a larger plant than in the case of

[1] New Jersey Stas. Bul. 85.

the early tomatoes. The fertilizing should be, therefore, such as to furnish an abundance of all the elements of plant food, and, inasmuch as the tomato belongs to the potash-consuming class of plants, the fertilizers used should be particularly rich in this element. It is not to be understood, however, that it is not necessary to apply nitrogen, for frequently soils are used that are either not naturally well adapted to the plant or have not been previously well supplied with vegetable matter containing nitrogen. On such soils additional nitrogen is very important, and nitrate of soda is one of the best forms to use, as it is absorbed fully by the roots, thus encouraging an early and vigorous growth of plant and a normal development of fruit. Slow-acting organic forms of nitrogen, on the other hand, frequently begin to feed the plant and cause its rapid growth when the energies should be concentrated in the growth and maturity of the fruit.

Fertilizers that have proven excellent are those which contain a relatively smaller amount of nitrogen than is required for early tomatoes and larger amounts of phosphoric acid and potash.

A study of the composition of both the fruit and vine of the tomato will serve to guide us in this respect, though the amounts and proportions of food removed by any crop are not an absolute guide, inasmuch as the soil may furnish more of one constituent than another, and because the plant may have the power of acquiring certain of its constituents more readily than others. In studying the amount of fertilizer to use, it is desirable to add more than will be contained in the increased crop, for two reasons: First, because it is impossible so to distribute the fertilizer as to enable the plant roots to come in contact with every portion of it, and second, because there is danger of loss of nitrogen by leaching, particularly during a wet season. The fertilizing constituents of the fruit and vines of tomatoes are as follows:

Fertilizing constituents in one ton of the fruit and vines of tomatoes.

	Nitrogen.	Phosphoric acid.	Potash.
	Pounds.	*Pounds.*	*Pounds.*
In fruit	3.20	1.00	5.40
Vines (green)	6.40	1.40	10.00

From this data it is calculated that in 10 tons of tomatoes, with the accompanying vines, which would probably reach 4 tons, there would be contained 57 pounds of nitrogen, 16 pounds of phosphoric acid, and 94 pounds of potash. On a good soil, therefore, which would, without manure, produce five to six tons, there should be added a sufficient excess of the constituents to provide for a maximum production, and the materials should be relatively richer in nitrogen and potash than in phosphoric acid. A mixture of nitrate of soda, 400 pounds; bone tankage, 700 pounds; acid phosphate, 400 pounds; muriate of potash, 500 pounds, would contain, approximately, 95 pounds of nitrogen, 144 pounds of phosphoric acid (48 pounds of which would be soluble and

available), and 250 pounds of potash in each ton. An application of 500 pounds of this mixture would furnish half as much nitrogen as is contained in 10 tons of crop, nearly as much immediately available phosphoric acid and two-thirds as much potash. Hence a dressing containing the amounts, kinds, and proportions of plant food here indicated would be regarded as very desirable, since one-half of the nitrogen is in the form of nitrate, which would contribute to the immediate growth of the plant. The amount of soluble and available phosphoric acid is sufficient to satisfy the needs of the crop throughout its entire growth, and such an abundance of potash is present as to insure the maturity of both plant and fruit. Formulas of this character have been used with good success, though the large proportion of salts sometimes make mixtures of this sort too moist to handle well, in which case a part of the potash, or even the nitrate, may be applied separately with advantage. On poorer soils the artificial supply of plant food should be proportionately greater, or sufficient to provide for the entire needs of a fair-sized crop, since, as a rule, the relative power of the plant to acquire food is somewhat less on poor soils than on good soils, or, stated in another way, the results from the use of fertilizers are proportionately better upon soils in good condition than upon those not well cared for. A good formula for use on these soils may consist of nitrate of soda, 500 pounds; bone tankage, 500 pounds; acid phosphate, 400 pounds; and muriate of potash, 600 pounds.

One ton of this mixture would furnish approximately 105 pounds of nitrogen, 120 pounds of phosphoric acid, and 300 pounds of potash. The application of 1,000 pounds would, therefore, furnish the food in sufficient abundance and in good proportions to meet the demands of a fair crop. The advantage of using so large a proportion of nitrogen in the form of nitrate is that in this form it is immediately available, and induces the immediate and rapid growth of the plant, and prevents a too late growth by furnishing a minimum of organic nitrogen, which would become available late in the season. The cost of the fertilizer suggested in these cases, though apparently rather large, should not exceed $15 per acre, and is no more than would be required for fertilizers to insure a maximum crop of corn, or other field crop, on the soils described. Besides, it must be remembered that the quality of the crop would also be greatly improved. The necessity for so expensive a dressing could be materially lessened by reducing the need for nitrogen, and this could be accomplished by sowing crimson clover with, or after, the previous crop of, say, early corn or potatoes; in fact, if weather conditions are favorable, crimson clover may be seeded in the tomato fields in August after cultivation has ceased, or at the last cultivation, and a crop of clover grown which will provide nitrogen for the next year's crop. This method is now practiced with advantage by many growers. The cost of manuring or fertilizing tomatoes on soils in good condition, and which have been well managed for previous crops in the rotation, should not exceed $8 per acre.

SETTING AND CULTIVATING THE PLANTS.

The plants should be set from 4 to 4½ feet apart each way and cultivation should begin immediately. The first cultivation should be deep, in order to conserve the moisture, and each subsequent cultivation shallower, in order not to destroy the roots, which will fill the soil as soon as the plants reach maturity. The crop in good seasons should begin to ripen in August, and picking will continue from that time until the last of September.

COST, YIELD, AND VALUE OF CROP.

The cost per acre is of course much smaller than in the case of early tomatoes (see p. 17), the reduction in cost of plants being especially marked. The several items may be classified as follows:

Cost of growing an acre of tomatoes for canning.

Plants	$2
Manures and fertilizers	8
Preparation of land, setting plants, and cultivation	8
Picking and carting	10
Total	28

The yield, as in the case of the early tomatoes, varies widely, ranging from 5 to as high as 20 tons per acre, even 30 tons per acre having been reported in exceptional cases, although the average for a series of years on average land will probably be under 8 tons. Where all conditions are carefully observed, 20-ton yields are frequently obtained, and at the prices received at the cannery, ranging from $5 to $7.50 per ton, according to the locality, the crop is a fairly good one and the net profits quite as high as for other field crops.

The agreements made between the growers and canners differ somewhat, though the main object on the part of the canner is to secure sufficient tonnage to maintain the factory during the ripening season. It would seem that the fairest form of contract would call for the product of a certain number of acres rather than the delivery of a certain number of tons. It is impossible for the farmer to anticipate the season, and therefore he can not safely contract to deliver a definite number of tons. The following form of contract, which is quite generally used in New Jersey, is good and protects both the producer and the canner:

Form of contract between tomato grower and canner.

This is to certify that we ———, have bought of ——— ———, the product of ——— acres of——— for the season of ——— at ——per ton, delivered at our cannery———. Stock to be in first-class merchantable condition. To be planted about ———.

Other provisions are frequently inserted to cover the date of the beginning of the delivery, as well as to protect the cannery in case of fire, accident, or other contingency.

The cooperation of farmers in the ownership and management of a cannery is practiced in a number of places, though it is not general.

TOMATOES IN THE GREENHOUSE.

The tomato is an important forcing-house vegetable, and may be made a profitable supplemental crop by those who are equipped with houses for growing plants for the outdoor early market crop. They can utilize their house for a winter crop of fruit before it becomes necessary for growing the plants for the field. It is very profitable when the conditions of growth are understood and carefully observed.

VARIETIES.

Few of the large number of varieties seem to be adapted for forcing. Those that have given the best results thus far are Lorillard, Chemin Market, Optimist, Ithaca, and Long Keeper. Of these, the Lorillard seems to fulfill the requirements as fully as any other sort grown in New Jersey. It is a good though not a prolific bearer, but the fruit is large, smooth, solid, and uniform in size. The Chemin Market is a rich-colored attractive tomato, but is uneven in outline and lacks solidity. Differences that are observed in the varieties in the more Northern States, with a minimum of sunshine, would perhaps not be so marked in winter climates having a larger proportion of sunshine.

THE HOUSE AND ITS MANAGEMENT.

The chief characteristic in a house is to have it light and tight, and high enough to allow the training of the plants to a height of at least 5 feet above the soil in the benches. Detailed information as to the character of houses and methods of growth and management are given in standard works on this subject.[1] The general plan of growing on benches is preferable; these should contain from 7 to 8 inches of soil, and lie immediately over the source of heat. In beds of this character the plants may be placed in rows 24 inches apart, and 18 inches apart in the row. The darker the house and the less the sunlight, the wider apart should the plants be set.

The proper temperature is from 60° to 65° F. for night, and about 75° F. for the day, at which temperature the house should be ventilated, though on bright days the temperature will run higher and will do no harm if it reaches 100° F. The atmosphere in the house should be kept in a well-moistened condition until the fruit begins to set, then the moisture should be reduced, as it hinders the setting of the fruit. Great care should be exercised in watering, especially on sunny days.

SOILS AND FERTILIZERS.

In growing forcing-house tomatoes, the character of the soil is apparently of less importance than the kind of manures and fertilizers and their method of use. It is our experience, as well as of others, that

[1] The Forcing Book, L. H. Bailey. The Macmillan Company, 1897. Greenhouse Management, L. R. Taft. Orange Judd Company, 1898.

tomatoes may be grown in almost any kind of soil, even coal ashes, provided an abundance of available food is supplied.[1] Where manure is convenient and cheap, a rich garden loam, to which at least one-fifth of rich stable manure has been added, is most excellent, though even this should be supplemented with liquid manure, or fertilizer, nearly every week after the plants begin to grow. In the absence of a supply of yard manure, a reasonably fertile, loamy soil may be used for filling the beds, in which may be mixed, for each 100 square feet of surface, one-half pound of nitrate of soda, 1 pound of acid phosphate, and one-half pound of muriate of potash. This application will supply the needs of the plants for food until fruit begins to develop, after which they should be fertilized at least once each week with one-quarter of a pound of nitrate of soda for every 100 square feet of surface area, and with the mineral fertilizers at the rate of 1 pound of acid phosphate and one-half pound of muriate of potash every two weeks. These may be applied in solution, or evenly distributed over the surface of the soil, and worked in before watering. In our experience, there is but little danger of overfeeding—the strongest and most vigorous plants have produced the largest yields and the best quality of fruit.

GROWING THE PLANTS.

The method recommended for growing the plants for the early market field crop apply fully in the case of those grown for forcing. The time required from sowing the seed until the plants are fit for transplanting in the beds ranges from two to two and one-half months. Hence if it is desired to have fruit by the middle of December, or the beginning of January, it is necessary to sow the seed early in August; these will then be ready to transplant in the house by the middle of October, and first fruiting will begin by Christmas time. The plants will continue to bear for longer or shorter periods, depending largely upon the method of training and feeding, though usually profitable picking will continue for from two to two and one-half months. Hence in order to secure a second crop in time to obtain fair prices, seed should again be planted in November, to begin fruiting in April. A person who makes a business of growing plants for early field crops could secure at least one house crop before the latter part of February, when it is necessary to plant his seed.

TRAINING THE PLANTS.

The plants should have sufficient water applied in such a manner as to thoroughly soak the soil—it should not be applied so as to puddle the surface and leave the lower layers dry. Experience thus far teaches that the best results are obtained by plants trained to a single stem, which are supported by stout strings attached to the rafters or other support above, and to which the individual plants are fastened

[1] New York Cornell Sta. Buls. 32 and 45; Connecticut State Sta. Rpts. 1895 and 1896; Massachusetts Hatch Sta. Buls. 10 and 15; Ohio Sta. Bul. 43.

by soft cord. Great care should therefore be exercised in pinching off the side shoots as they appear, and allowing only the blossom shoots to remain.

POLLINATION.

Experiments have shown that for the production of large even fruits, the tomato flowers must receive an abundance of pollen. Since pollen is discharged much less freely on damp cloudy days than at other times, it is desirable to pollinate artificially during a considerable part of the winter and early spring. Pollination is best done in the brightest part of the day when the atmosphere is comparatively dry. A very satisfactory way of distributing the pollen is to tap the blossom lightly with a small stick and thus jar the pollen out into a spoon, watch glass, or other convenient receptacle held below the flower, the pistil being depressed into the accumulated pollen at the same time. Pollinating may also be done by transferring the pollen from flower to flower with a camel's hair brush.

YIELDS.

When conditions are favorable, the average yield should be about 2 pounds for each 2 square feet of surface soil. The crop grown during the short winter days will always be slightly less than that grown when the days are lengthening.

MARKETS AND PRICES.

Care should be used in handling and putting up the fruit for market; it should not be bruised, and should preferably be placed in boxes holding from 4 to 10 pounds, each fruit wrapped in tissue paper and all carefully packed. The prices received will range from 10 to 50 cents per pound. The higher price is usually received in February and March, though in the past good prices have been received even after the Southern fruit comes in the market in considerable quantities, because of the superior quality of the greenhouse product.

With the prices obtained in the past the gross receipts for a season, December to May, from a house 20 by 100 feet, will range from $400 to $600, depending on the skill used in management.

INSECT PESTS AND REMEDIES.

An insect pest of the tomato, which frequently does great damage to the early-market crop, is the tomato worm; it is also known as the "corn worm" in the North, and the "boll worm" in the South.[1] This worm bores into the ripening tomato and is thus difficult to deal with directly. The caterpillar that matures in corn in September or early October goes under ground and changes to a pupa, passing the winter in this condition. If the ground remains undisturbed, the moth appears in early spring and lays its eggs upon such plants as it can find, and early tomato plants are one of its favorites. The caterpillars bore at first into the stems, but always attack the fruit as soon as it is

[1] Economic Entomology, J. B. Smith, pp. 303-304. J. B. Lippincott Co., 1896.

set and continue their ravages as long as fruit remains. Because they can not be treated except by picking and destroying fruit, the only practical method suggested is to fall plow all cornfields upon which tomatoes are to follow. The fall plowing breaks up the earthen cells in which the pupa rests and results in almost every instance in causing their death. The pest is not so serious where corn has not been previously grown, in which case the necessity for fall plowing is not so great; still, inasmuch as the practice is a good one in any case, it is to be recommended where trouble from this pest occurs.

Another pest, quite serious in some sections, is the Colorado potato beetle, which attacks the young plants as soon as they are set, and often does considerable damage. Here of course, before fruit has set, the usual remedy may be applied, namely, spraying with arsenites, at the rate of 1 pound in 75 to 100 gallons of water, in the same manner as for the destruction of the beetles when troublesome on potatoes.

A large green insect, called the "sphinx caterpillar," often does considerable injury. This insect is an external feeder, and the simplest remedy is to hand pick.

A small spotted mite is a pest which is frequently serious in the greenhouse; it feeds upon the under side of the leaves, causing the upper surface to appear speckled with white. The main remedy is the frequent syringing of the plants with fir-tree oil, used at the rate of one-half pint to 2 gallons of water.

The white scaly insect, which also does some injury, can be kept in check by fumigating with tobacco smoke.

The root gall, caused by a nematode worm, is also troublesome at times, in which case the soil should be removed from the house and only that used which has been thoroughly frozen.

FUNGUS ENEMIES OF THE TOMATO.[1]

In the Northern United States the most destructive disease of the tomato is the leaf spot (*Septoria lycopersici*). It is easily recognized by the affected foliage becoming covered with minute brown specks and finally drying up and falling away, leaving the bare stems, which are also more or less spotted by the fungus. The disease gains a foothold in the plants while they are quite young, and therefore great care should be taken to have everything in connection with the propagating beds in the best sanitary condition.

Experiments have shown that where this disease is prevalent tomatoes should not be grown continuously upon the same soil, and all stems of plants should be burned at the close of the season.

A second troublesome disease of the tomato is due to a bacterium (*Bacillus solanacearum*) and is recognized by a sudden wilting of the foliage, followed by a yellow color that finally becomes brown. This

[1] By Byron D. Halsted, D. Sc., botanist and horticulturist, New Jersey Agricultural Experiment Station, and professor of botany and horticulture, Rutgers College.

disease of the tomato was first complained of in the South, but it is now found as far north as Washington, D. C., and may be expected as a troublesome pest by the truckers around Philadelphia and New York.

Other plants belonging to the same family with the tomato are affected with the same disease, as the potato, eggplant, petunias, and several common weeds, such as the Jamestown weed, black nightshade, and ground cherry. This germ disease is therefore not so easily controlled as those that infest only one kind of plant.

Much depends upon the condition of the foliage, and anything that opens up a passageway for the entrance of the germs renders inoculation more frequent.

E. F. Smith, of the Department of Agriculture, who has made a special study of this trouble, finds that it is transmitted from one plant to another by insects, the Colorado beetle and the flea beetles being among the ones most active in this distribution.

One of the chief preventive measures is, therefore, to protect the tomato plants from the attacks of insects by the use of insecticides. In addition to this, any plant that shows the characteristic wilt should be removed and burned, thus destroying centers of infection. It is well to practice rotation and not grow tomatoes upon or close to land where the crop suffered the previous year. The same rule holds true with potatoes and eggplants, and no weeds of the tomato family should be allowed to grow in or near the area devoted to the crop.

The fruit rot, sometimes called black mold (*Macrosporium tomato*), is a fungus disease, which usually begins at the blossom end of the fruit. It is frequently accompanied by other fungi, that cooperate with it in causing the premature decay of the fruit.

Those varieties which have an imperfect blossom end are most susceptible, and care should be taken to grow the smooth-fruited sorts. For example, the rough-skinned soft fruits of the "peach" variety decay more extensively than the Dwarf Champion, with its smooth, hard fruit. The latter is an upright plant, and the fruit is less frequently upon the ground, and to this in some measure is due the comparative exemption from the fruit rot. This suggests the training of the vines to stakes or trellises, or using a straw mulch upon the soil to keep the fruit from touching the earth.

One of the most destructive of the fruit diseases is the anthracnose (*Colletotrichum phomoides*). This fungus attacks the fruit, usually producing small sunken places, which continue to enlarge until the tomato is ruined.

A common fungus disease of greenhouse tomatoes is the olive mold (*Cladosporium fulvum*). The infected leaves turn yellowish in patches, and upon the under side there is a felt-like olive-colored growth of mold, where the spores are produced in great numbers. The worst leaves should be removed and burned and spraying will help to keep the mold in check.

In conclusion, it may be said that fungus diseases of the tomato are found in all stages of the growth of the crop. Some begin in the propagating bed and flourish in the field upon leaf and stem. Others are confined to the fruit and destroy the tomatoes after they are picked, while some are usually present in the greenhouse.

They all produce spores or minute germs that are invisible and countless, and therefore all old vines should be destroyed and a wide rotation practiced by the trucker. It is to his advantage to set healthy plants, and be cautious in buying them or very careful in producing his own.

Many growers have found it profitable, after all other precautions are taken, to add spraying to the list of requirements in growing tomatoes. For this there is nothing superior to the Bordeaux mixture in any of its usual strengths.

FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C. Only the following are available for distribution:

No. 16. Leguminous Plants for Green Manuring and for Feeding. Pp. 24.
No. 18. Forage Plants for the South. Pp. 30.
No. 19. Important Insecticides: Directions for Their Preparation and Use. Pp. 20.
No. 21. Barnyard Manure. Pp. 32.
No. 22. Feeding Farm Animals. Pp. 32.
No. 23. Foods: Nutritive Value and Cost. Pp. 32.
No. 24. Hog Cholera and Swine Plague. Pp. 16.
No. 25. Peanuts: Culture and Uses. Pp. 24.
No. 26. Sweet Potatoes: Culture and Uses. Pp. 30.
No. 27. Flax for Seed and Fiber. Pp. 16.
No. 28. Weeds; and How to Kill Them. Pp. 30.
No. 29. Souring of Milk and Other Changes in Milk Products. Pp. 23.
No. 30. Grape Diseases on the Pacific Coast. Pp. 16.
No. 31. Alfalfa, or Lucern. Pp. 23.
No. 32. Silos and Silage. Pp. 31.
No. 33. Peach Growing for Market. Pp. 24.
No. 34. Meats: Composition and Cooking. Pp. 29.
No. 35. Potato Culture. Pp. 23.
No. 36. Cotton Seed and Its Products. Pp. 16.
No. 37. Kafir Corn: Characteristics, Culture, and Uses. Pp. 12.
No. 38. Spraying for Fruit Diseases. Pp. 12.
No. 39. Onion Culture. Pp. 31.
No. 40. Farm Drainage. Pp. 24.
No. 41. Fowls: Care and Feeding. Pp. 24.
No. 42. Facts About Milk. Pp. 29.
No. 43. Sewage Disposal on the Farm. Pp. 22.
No. 44. Commercial Fertilizers. Pp. 24.
No. 45. Some Insects Injurious to Stored Grain. Pp. 32.
No. 46. Irrigation in Humid Climates. Pp. 27.
No. 47. Insects Affecting the Cotton Plant. Pp. 32.
No. 48. The Manuring of Cotton. Pp. 16.
No. 49. Sheep Feeding. Pp. 24.
No. 50. Sorghum as a Forage Crop. Pp. 24.
No. 51. Standard Varieties of Chickens. Pp. 48.
No. 52. The Sugar Beet. Pp. 48.
No. 53. How to Grow Mushrooms. Pp. 20.
No. 54. Some Common Birds in Their Relation to Agriculture. Pp. 40.
No. 55. The Dairy Herd: Its Formation and Management. Pp. 24.
No. 56. Experiment Station Work—I. Pp. 30.
No. 57. Butter Making on the Farm. Pp. 15.
No. 58. The Soy Bean as a Forage Crop. Pp. 24.
No. 59. Bee Keeping. Pp. 32.
No. 60. Methods of Curing Tobacco. Pp. 16.
No. 61. Asparagus Culture. Pp. 40.
No. 62. Marketing Farm Produce. Pp. 28.
No. 63. Care of Milk on the Farm. Pp. 40.
No. 64. Ducks and Geese. Pp. 48.
No. 65. Experiment Station Work—II. Pp. 32.
No. 66. Meadows and Pastures. Pp. 24.
No. 67. Forestry for Farmers. Pp. 48.
No. 68. The Black Rot of the Cabbage. Pp. 22.
No. 69. Experiment Station Work—III. Pp. 32.
No. 70. The Principal Insect Enemies of the Grape. Pp. 24.
No. 71. Some Essentials of Beef Production. Pp. 24.
No. 72. Cattle Ranges of the Southwest. Pp. 32.
No. 73. Experiment Station Work—IV. Pp. 32.
No. 74. Milk as Food. Pp. 39.
No. 75. The Grain Smuts. Pp. 20.
No. 76. Tomato Growing. Pp. 30.
No. 77. The Liming of Soils. Pp. 19.
No. 78. Experiment Station Work—V. Pp. 32.
No. 79. Experiment Station Work—VI. Pp. 28.
No. 80. The Peach Twig-borer—an Important Enemy of Stone Fruits. Pp. 16.
No. 81. Corn Culture in the South. Pp. 24.
No. 82. The Culture of Tobacco. Pp. 23.
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